

Special Issue on Communications and Networking

Approaches for Combating COVID-19

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The COVID-19 pandemic has had an impact across the globe. This includes the many lives lost and the severe disruption to economies and daily lives. Researchers in a variety of fields have been motivated to use their expertise to help address the many challenges of this on-going pandemic. Communication and Networking researchers are among these. Communications and networking technologies can be utilized to help facilitate contact tracing and other forms of remote health monitoring. Epidemic models developed for studying the propagation of information and viruses in communication networks can be adapted to study the propagation of a true epidemic like COVID-19. Techniques such as machine learning can be utilized to make better predictions from limited public health data. Approaches for security and privacy can be leveraged to protect confidential health information. The goal of this special issue of the *Journal of Communications and Networks* is to highlight some of the work being done in these important areas.

From the submissions we have accepted 7 papers to appear in this issue.

The first paper, "*Modeling COVID-19 with Mean Field Evolutionary Dynamics: Social Distancing and Seasonality*," proposes mean field evolutionary dynamics (MFEDs) as a new approach for modeling the evolution of COVID-19. This approach is inspired by optimal transport theory and mean field games on graphs. This model is used to study the impact of one-time social distancing and seasonality through the post pandemic period.

The second paper, "*Optimization of Resource-Constrained Policies for COVID-19 Testing and Quarantining*," is motivated by the limited availability of PCR tests, which was especially acute during the early days of the pandemic. The authors provide a framework that utilizes a stochastic disease model and a "community graph" model to study different testing and quarantine policies.

The third paper, "*Measuring the Impact of COVID-19 Restrictions on Mobility: A Real Case Study from Italy*," performs data mining on a vehicular mobility dataset from Bologna, Italy during a period that includes the first lockdown phase in Italy. The analysis is used to study the impact of mobility restrictions on traffic flows.

The fourth paper, "*Applying a Deep Learning Enhanced Public Warning System to Deal with COVID-19*," is motivated by public warning systems that are used by some governments to quickly deliver information related to COVID-19. These systems broadcast text messages over cellular networks within a given area. The authors apply deep learning and Generative Adversarial Networks (GANs) to optimize the broadcast area to better target where messages are sent.

The fifth paper, "*Privacy-preserving COVID-19 Contact Tracing using Blockchain*," presents an approach for preserving user privacy when collecting information for contact tracing. Their approach utilizes homomorphic encryption and a permission-less blockchain network.

The sixth paper, "*WeTrace: A Privacy-preserving Tracing Approach*," presents an approach that utilizes the Bluetooth Low Energy (BLE) communication, Global Positioning System (GPS) and public-key cryptography for collecting user data that can be used for contact tracing while maintaining user privacy.

The seventh paper, "*Energy Efficient Contact Tracing and Social Interaction based Patient Prediction System for COVID-19 Pandemic*," also utilizes BLE and GPS for contact tracking. The focus of this paper is on developing an infection prediction algorithm that utilizes the collected data to determine the probability that a given user is infected and alert the user if their risk warrants this. Approaches for reducing the required energy of the proposed approach are also given.

We would like to thank all of the authors who submitted their work to this special issue. We are equally grateful to all reviewers, whose critical comments and suggestions contributed to the quality of this special issue. Finally, we want to acknowledge Grace Kim for her support throughout the process of preparing this special issue.



Randall Berry joined Northwestern University in 2000, where he is currently the Chair and John A. Dever Professor in the Department of Electrical and Computer Engineering. His research interests span topics in wireless communications, computer networking, network economics, and information theory. Dr. Berry received the M.S. and PhD degrees in Electrical Engineering and Computer Science from the Massachusetts Institute of Technology in 1996 and 2000, respectively, where he was part of the Laboratory for Information and Decision Systems. His undergraduate education was at the University of Missouri-Rolla, where he received the B.S. degree in Electrical Engineering in 1993. In 1998 he was on the technical staff at MIT Lincoln Laboratory in the Advanced Networks Group. Dr. Berry is the recipient of a 2003 NSF CAREER award and an IEEE Fellow.

With his co-authors, he has received best paper awards at the IEEE Workshop on Smart Data Pricing in 2015 and 2017 and at the 2016 WiOpt conference. He has served as an Editor for the IEEE Transactions on Wireless Communications and the IEEE Transactions on Information Theory and is currently a division editor for the Journal of Communications and Networks and an Area editor for the IEEE Open Journal of the Communications Society. He has served on the program and organizing committees of numerous conferences including serving as the co-chair of the 2012 IEEE Communication Theory Workshop and a technical co-chair of 2010 IEEE ICC Wireless Networking Symposium.

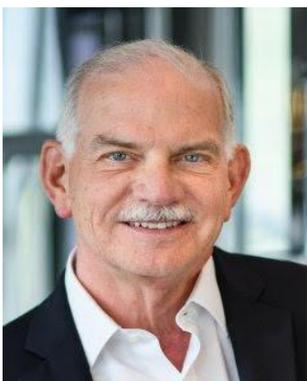


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promise of innovative applications, with the following citation: "for contributions to game theory and distributed management of autonomous communication networks."



Krishna Narayanan received the Ph.D. degree in Electrical Engineering from Georgia Institute of Technology in 1998. Since 1998, he has been with the Department of Electrical and Computer Engineering at Texas A&M University, where he is currently the Eric D. Rubin professor. His research interests are broadly in information theory, data science and signal processing with applications to wireless communications and data storage. He was the recipient of the NSF early career award in 2001. He also received the 2006 and 2019 best papers award from the IEEE technical committee for signal processing for data storage and a 2018 best paper award at the conference on vehicular electronics and safety. He served as an associate editor for coding techniques for the IEEE Transactions on Information Theory from 2016-2019. He served as the area editor (and as an editor) for the coding theory and applications area of the IEEE Transactions on Communications from 2007 until 2011. In 2014, he received the Professional Progress in Engineering award given to an outstanding alumnus of Iowa State University each year under the age of 44. He was elected as Fellow of the IEEE for contributions to coding for wireless communications and data storage. He has won several awards within Texas A&M university including the 2017 University level distinguished achievement award for teaching. He has given several invited lectures and was an invited speaker at Information Theory schools in North America, Australia and East Asia in 2016, 2017 and 2019.



H. Vincent Poor received the Ph.D. degree in EECS from Princeton University in 1977. From 1977 until 1990, he was on the faculty of the University of Illinois at Urbana-Champaign. Since 1990 he has been on the faculty at Princeton, where he is currently the Michael Henry Strater University Professor. During 2006 to 2016, he served as the dean of Princeton's School of Engineering and Applied Science. He has also held visiting appointments at several other universities, including most recently at Berkeley and Cambridge. His research interests are in the areas of information theory, machine learning and network science, and their applications in wireless networks, energy systems and related fields. Among his publications in these areas is the forthcoming book *Machine Learning and Wireless Communications* (Cambridge University Press). Dr. Poor is a Member of the U.S. National Academy of Engineering and the U.S. National Academy of Sciences, an Honorary Member of the National Academy of Sciences, Republic of Korea, and a Foreign Member of the National Academy of Engineering of Korea. He received the IEEE Alexander Graham Bell Medal in 2017.



Christos Verikoukis got his PhD from the Signal Theory and Communications Department of the Technical University of Catalonia (UPC), Barcelona, in 2000, in the area of Broadband Indoor Wireless Communications. He has received the best paper award of the Communication QoS, Reliability & Modelling Symposium (CQRM) symposium in the IEEE ICC 2011 & ICC 2014, of the Selected Areas in Communications Symposium in the IEEE GLOBECOM 2015, of the EUCNC 2016 conference, the EURASIP 2013 Best Paper Award for the Journal on Advances in Signal Processing and the Best Demo Award in IEEE CAMAD2018. He is currently serving as the Associate Editor-in-Chief of the IEEE Networking Letters and as an Associate Editor of the IEEE Communications Surveys and Tutorials, of the IEEE Networks Magazine and of the IEEE Transactions of Green Communications and Networking. Moreover, he has served as a Guest Editor in 14 special issues in prestigious Journals and Magazines (IEEE Communications Magazine, IEEE Networks Magazine, IEEE Wireless Communications Magazine etc.). He was the general Chair of the 17th, 18th, 19th, 20th and the 22nd IEEE Workshop on Computer-Aided Modelling, Analysis and Design of Communication Links and Networks (CAMAD), the TPC Co-Chair of the 15th IEEE International Conference on eHealth Networking, Application & Services (Healthcom) and the 7th IEEE Latincom. He was also served as the symposium co-chair of the CQRM symposium in the IEEE ICC 2015 & 2016 and in the IEEE Globecom 2017 as well as of the eHealth Symposium in IEEE Globecom 2015. He was an officer (Secretary 2013-2014, Vice-Chair 2014-2015 and Chair 2015-2018) of the IEEE ComSoc Technical Committee on Communication Systems Integration and Modelling (CSIM) and Vice-Chair of the IEEE ComSoc Technical Committees Board (2019-2020) He is currently a Member of the IEEE ComSoc Board of Governors, Member-at-Large of the IEEE ComSoc GITC and IEEE ComSoc EMEA Director.



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